Motiv Emot (2006) 30:249–256
DOI 10.1007/s11031-006-9032-y

ORIGINAL PAPER

Aiming at Happiness: How Motivation Affects Attention to and Memory for Emotional Images

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Published online: 27 July 2006

Abstract Socioemotional Selectivity Theory (Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). *American Psychologist*, *54,* 155–181) posits that older adults, and anyone else who perceives their time as limited, show a motivational shift toward emotion regulation which causes them to exhibit a positivity bias and negativity avoidance in attention and memory. We tested whether such a motivational shift can indeed cause changes in emotional processing by manipulating motivation in a sample of young adults. After the manipulation, participants looked at real-world images while their eye movements were tracked. It was found that participants motivated to regulate emotion attended less to negative than positive images and showed less looking time to all stimulus types compared to the other two conditions. No evidence was found linking the motivational manipulation to emotional memory.

Keywords Socioemotional selectivity theory · Positive effect · Attention · Memory

In recent years, a positivity effect has been suggested in older adults' attention and memory (see, for example, Carstensen & Mikels, 2005). A positivity effect is composed of two aspects: positivity bias and negativity avoidance. A positivity bias can be depicted as proactively attending to positive information and strengthening positive information in memory; while the negativity avoidance involves shifting attention away from negative stimuli and diminishing negative information in memory.

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Both positivity bias and negativity avoidance in older adults' attention have been suggested from previous studies (e.g., Isaacowitz, Wadlinger, Goren, & Wilson, 2006; Mather & Carstensen, 2003). For example, in a dot-probe study, it was found that older adults responded slower to dots that appeared after negative faces, suggesting that they have an attentional bias away from negative faces. In contrast, young adults showed no such bias (Mather & Carstensen, 2003). However, in a recent study using eye tracking, both positivity bias and negativity avoidance were found in older adults' attention. Specifically, older adults shifted attention away from angry faces and attended more to happy faces, while young adults looked more at afraid faces (Isaacowitz et al., 2006).

The memory literature has been fairly consistent in finding a positivity bias in older adults' memory. Mather and Carstensen (2003) found that older adults remembered previously presented positive faces better than negative faces compared to young adults. Similarly, another study found that the proportion of positive images accurately recalled or recognized increased with age across young, middle-aged and older participants (Charles, Mather, & Carstensen, 2003). This positivity bias has also been found in long-term memory. When adolescents, young adults and older adults were asked to cite the most important episode in their moral development, older adults were more likely to recall a positive experience (Quackenbush & Barnett, 2001).

Socioemotional selectivity theory

Socioemotional Selectivity Theory (SST) provides an explanation for the positivity effect in older adults' attention and memory by linking time perspective and motivational shifts. According to SST, young adults perceive their time as

expansive and are motivated toward knowledge acquisition that they can bank for the future, even at the cost of emotional satisfaction. In contrast, older adults perceive that their remaining time is limited and are more motivated toward regulation of emotion, which can benefit their current life (Carstensen, Isaacowitz, & Charles, 1999). While age and time perspective are inevitably associated, the motivational effects posited by the theory are centered on the influence of time perspective and are therefore at least theoretically separable from chronological age.

There is evidence supporting the position that motivation is responsible for the positivity effect in attention and memory, as would be predicted by SST. Pruzan and Isaacowitz (2006) examined the attentional patterns of college seniors and freshmen. It was assumed that college freshmen would anticipate their college life as unlimited, while seniors would regard their life in college as approaching an ending. Thus, these two groups would differ in motivation with senior students mimicking older adults' motivation while freshmen would be consistent with young adults' motivation. It was found that senior students looked significantly less at sad faces than did freshmen. In another study examining autobiographical memory, young adults who were induced to focus on their emotional state remembered the past more positively than those focused on accuracy of their recall memory (Kennedy, Mather, & Carstensen, 2004).

Emotion regulation and attention

Individuals may control their attentional focus as a way of regulating their emotion. Gross (1998) classified such attentional control strategies into three categories: concentration, distraction and rumination. Concentration refers to the process of paying attention to the emotional aspects of a situation. Distraction involves directing attention toward nonemotional items in the environment or shifting away from the immediate surroundings altogether. Rumination entails focusing on specific emotions and their consequences, which may serve to magnify the experience of the emotion.

As reviewed above, older adults' emphasis on emotion regulation has been linked with a positivity effect in their information processing (e.g., Carstensen, Fung, & Charles, 2003; Mather & Carstensen, 2003). This suggests that older adults may favor Gross' strategy of concentration in their emotion regulation because distraction involves focusing away from any emotional content altogether. Emotional information in general has been found to be particularly salient to older adults (e.g., Fung & Carstensen, 2003), implying that they are unlikely to distract from emotional material altogether when attempting to regulate their emotions. In contrast, it is somewhat of an open question as to which if any of the three strategies young adults would preferentially adopt to control their attentional focus when they are motivated to regulate emotion.

Current study

The current study further tested the motivational account of the positivity effect in older adults' attention and memory provided by SST. It was proposed that the motivational shift of older adults toward emotion regulation is responsible for the positivity bias and negativity avoidance in their attention and memory. An experimental manipulation was used to mimic the motivational style of young and older adults respectively. Young adults were randomly assigned to one of the three conditions: an emotional condition, an informational condition and a control condition. Participants in the emotional condition were experimentally induced to mimic the motivational pattern of older adults (and other groups who perceive their time as limited); participants in the informational condition were induced to mimic the motivational pattern of young adults (and those who perceive time as open-ended). There was also a control condition without any motivational manipulation. The purpose for including the control condition was to examine if the motivational induction used for the informational condition is indeed the default motivational state of young adults. We tested whether motivation could lead to differences in attention and recall memory by examining if the participants in the three conditions differed in their attentional patterns and memory biases.

In addition, by examining if the participants in the emotional condition would show a positivity bias and negativity avoidance in their attention, we tested whether young adults motivated to mimic the motivational state of older adults would use the same strategy to control their attentional focus as older adults have been found to use in past studies (e.g., Mather & Carstensen, 2003).

Attention and eye tracking

In the current study, attention was measured by tracking the participants' eye movements while they were looking at images varying in valence on a computer screen. Eye tracking allows for the measurement of visual attention in nearly real time. Although under some circumstances it is possible to look at something and visually attend to something else, eye movements and visual attention generally correspond under normal viewing (Parkhurst, Law, & Niebur, 2002). Percentage of looking time to the "Area of Interest (AOI)"—-the image presented in the middle of the screen—-was used as the primary attentional measure because it corrects for within-subject fixation tendencies, and it also minimizes bias to fixation estimates caused by tracking.

Hypotheses

Based on previous research, there were two main hypotheses in this study: (1) participants in the emotional condition would show both positivity bias and negativity avoidance in their attention as compared with the informational and control condition; (2) participants in the emotional condition would show only positivity bias in memory when compared with the other two conditions.

Method

Materials and apparatus

Visual stimuli were real-world images selected from the International Affective Picture System (IAPS: CSEA-NIMH, 1999). The emotional valence and arousal level of each image were provided in the IAPS manual (Lang, Bradley, & Cuthbert, 2001). The emotional valence for each picture was rated on a Likert scale from 1 (being the most negative) to 9 (being the most positive); the emotional arousal of each image was also rated from 1 (being low arousal) to 9 (high arousal). Images with IAPS values of 1–4 for emotional valence were selected as negative images ($M = 3.01$, $SD = 0.75$), values of 4–6 were chosen as neutral ($M = 5.21$, $SD = 0.34$), and values of 6–9 were included as positive images ($M = 7.46$, $SD = 0.24$). This classification is consistent with typical categorizations for positive, negative, and neutral images (e.g., Charles et al., 2003). In addition, the emotional arousal of stimuli was similar between and within each valence group. The IAPS arousal level for the positive images ($M = 5.17$, $SD = 0.88$) and negative images ($M = 5.43$, $SD = 0.80$) were not different, $F(1, 19) = 0.45$, n.s.; however, the arousal level for the neutral images was somewhat lower ($M = 3.70$, $SD = 0.62$).

An ASL Eye Tracker 504 with Magnetic Head Transmitter was used to record the gaze of the participants' left eye. Stimuli were presented in a slide-show format on a 15-inch computer monitor. MATLAB software was used to activate the eye tracker software to record participants' attention upon the onset of visual stimuli automatically. Percentage of possible looking time to the pictures was used as the primary measure of attention. Within each trial, one picture was presented on the center of the screen for 10 s. Ten trials were composed of positive images, 10 trials were neutral images, and 10 were negative images. The background of the slides varied in order to potentially distract the participants' attention away from the picture in the center. There were ten backgrounds chosen from the slide design default in Microsoft Office PowerPoint 2003 which differed in colors but were approximately equal in amount of complexity. Each of the backgrounds was combined with one positive, one neutral and one negative image. Compared to the target IAPS images, the backgrounds contained far fewer lines, objects and colors, and thus were much less complex visual stimuli than the targets. Two random orders of the 30 trials were employed. The first half of the participants viewed the images in one order; while the second half of the participants viewed the reversed order of slides.

Participants

Participants were 84 undergraduate students from a small Northeastern university, aged 18–22 ($M = 19.13$, $SD = 1.10$), 30 males and 54 females. Participants were randomly assigned to three conditions: 28 in the control condition, 27 in the informational condition, and 29 in the emotional condition. Due to tracking difficulties, data was lost for some trials from some participants (less than 5% of the 30 trials for any given participant); in these cases, means were computed only from the successful trials were used. Three additional participants could not be tracked at all, thus their data was not used in the analyses.

Procedure and experimental manipulation

Upon the participants' arrival at the lab, they first signed the consent form and had their vision tested using two standard measures: a Snellen test of visual acuity, and a Pelli-Robson test of contrast sensitivity (Pelli, Robson, & Wilkins, 1988). Their vision could be corrected by glasses or soft contact lenses, but no hard contact lenses were allowed. Then they completed a brief questionnaire concerning demographic information.

In the eye tracker room, participants first read the instructions that varied between the three conditions. The instruction was used to manipulate the participants' motivation to mimic the motivational style of young or older adults. Specifically, the instruction for the emotional condition was "You are going to see 30 real-world images. Each will be presented in the center of the screen for 10 s. You may look wherever you want. The most important thing is to try to manage how you feel as you see the images." This instruction was assumed to motivate participants to focus on emotion regulation, which would be consistent with past findings on older adults' motivation (Carstensen et al., 1999).

The instruction for the informational condition asked participants to focus on information acquisition which is consistent with young adults' motivation. Specifically, the instruction was "You are going to see 30 real-world images. Each will be presented in the center of the screen for 10 s. You may look wherever you want. The most important thing is to try to get as much information as possible from each image."

The instruction for the control condition was "You are going to see 30 real-world images. Each will be presented in the center of the screen for 10 s. You may look wherever you want. The most important thing is to look at them naturally as if you are at home watching TV."

The motivational instructions for the emotional and informational condition were consistent with the predictions of SST[1]; the instruction for the control condition has been used in past work to elicit natural looking patterns on the computer screen (e.g., Isaacowitz, 2005). We included in our instructions that "you may look wherever you want" to inform the participants they were not obliged to focus on the image only, and they can look at both the image and the background.

After calibration, the participants' left eye was tracked while they looked at the images presented on the computer screen. After the eye tracking process that lasted 3 min, there was a surprise memory test. Participants were asked to recall as many of the pictures they had seen during the eye tracking session as possible and use short phrases to describe each of them. They could list the images in any order. As long as the experimenter could determine which picture they were describing, it was calculated as a correctly remembered image. For example, for the first picture in Fig. 1, as long as the description contained "water skiing" or "surfing," it was counted as a correctly remembered picture. The number of images correctly recalled by each participant was counted. The accuracy of recalled images was close to 100%, which means once an image was recalled by a participant, it was almost always right. But not everyone remembered every image. The overall percentage of images recalled was 49.5%.

As a manipulation check, the participants were given a multiple-choice question, of which the three options to choose from were instructions of each of the three experimental conditions. Participants were asked to indicate which option contained the same instruction as they read during the motivational manipulation. This procedure was used to make sure that the participants were motivated in the manner that we had expected. All of the participants successfully passed the manipulation check. Finally, the participants were fully debriefed about the purpose of the study and dismissed.

Fig. 1 Examples of positive, neutral and negative images presented on the computer screen during the eye tracking session (originals were in color)

Results

A MANOVA was conducted to test whether attentional style and recall memory of participants in the different motivational conditions was affected by gender and class year. The dependent variables were attention and memory to positive,

[1] The motivational manipulations used in this study—"acquisition of knowledge" and "regulation of emotion" are consistent with the two categories of motivation predicted by SST (Carstensen et al., 1999), although there have been some variations regarding older adults' motivational state in the most recent work on SST (see Carstensen & Mikels, 2005, for example). Specifically, some recent work has suggested that older adults' motivation might be not to regulate emotions per se but rather to optimize positive affect and minimize negative affect (Carstensen et al., 2003). Thus, while the current study tried to mimic one possible motivational state that older adults may hold, future research (both using older adults directly as well as using young adults to mimic the motivation) could try to distinguish between the emotion regulation and emotional satisfaction motivations more specifically.

neutral and negative images; the independent variables were gender, class year and condition. No main effects or interaction effects was found for gender or class year for any of the emotional stimuli. Thus, data was collapsed across participant sex and class year for further analysis. There was no difference between the two presentation orders on attention to and memory for the images. Data was therefore also collapsed across the two presentation orders.

Hypothesis 1: The effect of motivational style on attentional patterns

A mixed-model analysis of variance was performed with one within-subject factor (stimulus type: positive, neutral, or negative) and one between-subject factor (motivational condition: control, information, or emotion). The dependent variable was percentage of looking time to the stimuli in the full 10 s. Main effects of both stimuli type, $F(2, 162) = 14.96$, $p < .01$ and motivational condition, $F(2, 81) = 7.29$, $p < .01$ emerged. Testing within-subject contrasts found that negative stimuli ($M = 85.83$, $SD = 13.15$) received less attention from participants than positive stimuli ($M = 90.82$, $SD = 7.76$), $F(1,81) = 22.18$, $p < .01$, $d = 0.46$, or neutral stimuli ($M = 88.32$, $SD = 8.86$), $F(1, 81) = 6.35$, $p < .05$, $d = 0.22$. A simple contrast revealed that participants in the emotional condition looked less at the stimuli ($M = 83.65$, $SD = 10.05$) than their counterparts in the informational ($M = 91.63$, $SD = 7.35$, $p < .01$, $d = 0.90$) and the control ($M = 89.97$, $SD = 7.08$, $p < .01$, $d = 0.72$) conditions. There was also a Stimuli Type × Motivational Condition interaction effect, $F(4, 162) = 4.76$, $p < .01$.

In order to further examine this interaction, paired-samples *t*-tests were conducted. Participants in the emotional condition looked less at negative images compared with the control condition, $t(27) = 3.03$, $p < .01$, $d = 0.81$, and the informational condition, $t(26) = 3.79$, $p < .01$, $d = 1.07$. Unexpectedly, it was found that participants in the emotional condition also paid less attention to positive images in comparison with the control condition, $t(27) = 2.35$, $p < .05$, $d = 0.60$, and the informational condition, $t(26) = 2.25$, $p < .05$, $d = 0.57$. No difference was found in percent of looking time to positive ($t(26) = .04$, n.s.), neutral ($t(26) = .74$, n.s.) or negative stimuli ($t(26) = 1.08$, n.s.) between the informational and control conditions.

Next, within-group effects were tested. Within the emotional condition, paired-samples *t*-tests revealed that, as predicted, negative stimuli ($M = 78.17$, $SD = 16.66$) were viewed less than positive stimuli ($M = 87.84$, $SD = 8.57$), $t(28) = 3.55$, $p < .01$, $d = 0.73$ and neutral stimuli ($M = 84.95$, $SD = 10.10$), $t(28) = 2.81$, $p < .01$, $d = 0.49$. No such bias was found for participants in the informational condition (positive: $M = 92.53$, $SD = 7.82$; neutral: $M = 91.11$, $SD = 8.11$; negative: $M = 91.26$, $SD = 7.36$). In other words, participants in the informational condition looked equally across stimuli types. Although not included in our prediction, it was also found that negative stimuli ($M = 88.52$, $SD = 9.58$) received less attention than positive stimuli ($M = 92.27$, $SD = 5.92$), $t\ (27) = 3.44$, $p < .01$, $d = 0.47$, when participants were in the control condition.

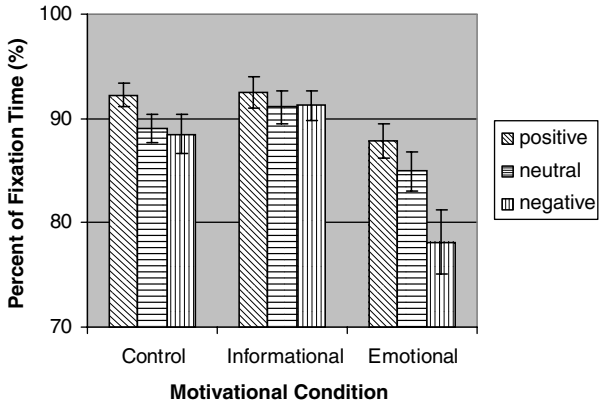

Fig. 2 Percent of fixation time to three types of stimuli of participants in three motivational conditions. Participants viewed the images presented one by one on the computer screen for 10 s. Bars with diagonal lines represent positive images, bars with horizontal lines indicate neutral images, and bars with vertical lines show negative images. X-axis indicates the motivational condition to which participants were randomly assigned. Note. Paired-samples *t*-tests indicated that negative images were viewed less than positive ($^{**}p < 0.01$) and neutral stimuli ($^{**}p < 0.01$) when the viewer was in the emotional condition. Bars represent the percent of looking time to AOIs. AOI referred to the image presented in the middle of the screen which was used as the primary attentional measure in the current study. Error bars indicate the standard error of the percent of looking time to AOI

However, as shown in Fig. 2, descriptive data and *t*-tests revealed that participants in the emotional condition looked much less at negative stimuli than positive stimuli (9.67% less looking time, $t(28) = 3.55$, $p < .01$, $d = 0.73$) when compared with those in the control condition (percent of looking time on negative stimuli was 3.75% less than positive ones, $t(27) = 3.44$, $p < .01$, $d = 0.47$). A paired-samples *t*-test found this difference to be significant, $t(27) = 2.01$, $p = .05$, $d = 0.55$.

Hypothesis 2: The effect of motivational style on recall memory

The above mixed-model analysis of variance was re-run, with the number of images correctly recalled by participants as the dependent variable. The within-subject factor was stimuli type and between-subject factor was motivational condition. Significant main effects were found for stimulus type, $F(2, 162) = 62.20$, $p < .01$, and motivational condition, $F(2, 81) = 4.90$, $p < .01$. As shown in Fig. 3, a within-subject simple contrasts showed that participants recalled fewer neutral stimuli ($M = 3.56$, $SD = 1.52$) than negative

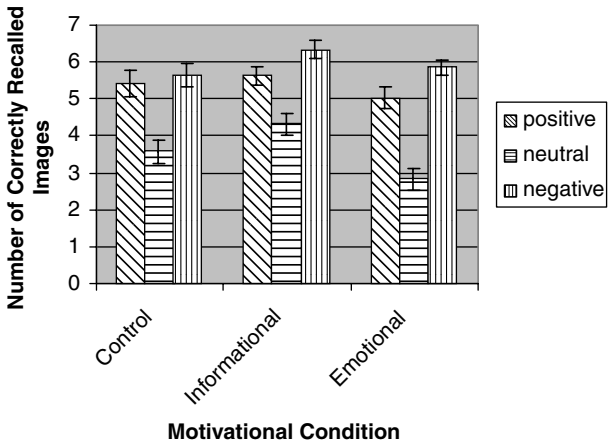

Fig. 3 Number of three types of images correctly recalled by participants in three motivational conditions. Note. One-way ANOVA found significant main effects for stimulus type ($p < .01$) and motivational condition ($p < .01$). No interaction effect was found. Bars represent the number of correctly recalled images. Error Bars indicate the standard error of the number of correctly remembered images

($M = 5.94, SD = 1.43$), $F(1, 81) = 118.15, p < .01, d = 1.61$, and positive stimuli ($M = 5.36, SD = 1.81$), $F(1, 81) = 57.75$, $p < .01, d = 1.08$. A Tukey post-hoc test indicated that participants in the informational condition ($M = 5.43$, $SD = 0.99$) recalled more images than those in the emotional condition ($M = 4.57$, $SD = 0.95$, $p < .01$, $d = 0.89$). Contrary to our prediction, there was no Stimuli Type × Motivational Condition interaction effect, $F(4, 162) = 1.49$, *n.s.*

Discussion

Socioemotional Selectivity Theory (Carstensen et al., 1999) predicts that older adults' motivational shift toward emotion regulation could be the basis of their positivity bias and negativity avoidance in attention and memory (Carstensen & Mikels, 2005). In order to test this possibility, the current study investigated the influence of different motivational styles on attentional pattern and recall memory. Young participants' motivation was manipulated to mimic the motivational style of young (informational condition) or older adults (emotional condition). There was also a control condition without any manipulation to assess the naturalistic looking pattern of young adults. An eye tracker recorded where participants looked as they viewed positive, neutral and negative images on the computer screen, and recall memory was tested. We predicted that, in comparison with participants in the informational and control conditions, those in the emotional condition would show both a positivity bias and a negativity avoidance in attention, and show a positivity bias in memory. These predictions were based on the assumption that participants in the informational condition would mimic young adults' naturalistic patterns in motivation, attention and memory. We found negativity avoidance in the attentional patterns of participants in the emotional condition, partially supporting the first hypothesis. There was no support for our second hypothesis concerning memory.

Motivation predicted different attentional patterns

Findings from the attentional data supported the prediction that participants in the emotional condition would show an attentional bias away from negative stimuli while participants in the informational and control condition would not show such bias. Specifically, negative stimuli received less attention from participants in the emotional condition compared to those in the informational and control conditions; participants in the emotional condition looked far less at negative images than positive images. Although participants in the control condition also attended less to negative than positive images, the effect was significantly stronger for the emotional condition. However, the current study only found negativity avoidance, but not a positivity bias in attention.

Since the participants were all undergraduate students from the same university and they were randomly assigned to each of the three conditions, it was assumed that participants' emotional state and cognitive ability did not differ between the three conditions. Nonetheless, we still were able to conduct one check to ensure our matching worked: there was no difference in a composite negative affect scale across the three conditions. Thus, random assignment was utilized to minimize the potential effect of emotional state and cognitive ability on attention and memory. Since the only systematic difference between participants in each condition was their motivational condition, the current study supported the argument that difference in motivation could be the basis for differential attentional bias, at least for negatively-valenced stimuli.

Attention and emotion regulation strategies: Concentration, distraction or rumination?

It is important to recognize that participants in the emotional condition showed less looking time at positive images and overall less looking time at all image types compared with those in the other two conditions. This finding suggests that, when motivated toward emotion regulation, young adults might try to avoid any affective response to the stimuli by shifting attention away from all types of stimuli. This strategy could be best described as distraction according to the classification of Gross (1998). This differs from findings suggesting that older adults use concentration more than distraction (e.g., Mather & Carstensen, 2003). Our finding implies that young and older adults might use different attentional control strategies when motivated to regulate their emotional

state. Further study may repeat this experiment in a sample of older adults to test directly what their default motivation is and to compare their attentional pattern and memory with their younger counterparts; this would also clarify recent questions concerning whether older adults are motivated to regulate (Carstensen et al., 1999) or optimize (Carstensen & Mikels, 2005) their emotions.

Motivation did not affect memory patterns

The results did not support our second hypothesis of a memory bias toward positive stimuli of participants in the emotional condition. Specifically, participants in each of the three conditions all recalled fewer neutral stimuli than negative and positive stimuli. However, participants in the informational condition recalled more images than those in the emotional condition. In other words, participants who were motivated toward information acquisition remembered more images, which suggested that motivation did have some impact on memory.

A recent study suggested that memory biases favoring positive over negative stimuli in a sample of older adults may have been generated from goal-directed processes (Mather & Knight, 2005). Thus, the lack of finding regarding motivational effect on memory to differently-valenced stimuli might be caused by the fact that the participants' motivation was manipulated before the attentional task but was not manipulated again for the memory test. Instead, participants in all of the three conditions received the same instruction: try to recall as many images as possible. Consequently, it may not be surprising that participants in all of the three conditions showed the same pattern of memory bias.

Implications for socioemotional selectivity theory

The current study supported the prediction of SST that the default motivational style of young adults was information acquisition. Young participants without motivational induction showed the same pattern in attentional preference and recall memory as those who were motivated toward knowledge acquisition. According to this result, the default motivation for young adults was the same as the motivational induction used in the informational condition, which was information acquisition.

Previous studies testing SST suggested that older adults attend less to negative stimuli and more to positive stimuli (e.g., Isaacowitz et al., 2006). The current study found that young adults motivated to regulate their emotions not only looked less at negative stimuli (which is consistent with previous findings), but also attended less to positive stimuli (which is inconsistent with previous findings). This may be one case in which using young adults to mimic age-related findings might not be feasible. As discussed above, young and older adults may use different strategies in emotion regulation. Subsequently they show different patterns in their visual attention. Future research is needed to specify age differences in the use of visual attention specifically in the service of emotion regulation.

The lack of support regarding different memory biases due to differential motivational style is inconsistent with previous research comparing the memory bias between young and older adults, which have found strong evidence for the positivity bias in memory among older individuals (e.g., Charles et al., 2003). This may be another situation in which using young adults could not mimic age-related findings. Older adults' declining cognitive ability might be a possible cause of the discrepancy. Specifically, if older adults are indeed forgetting material due to age-related cognitive decline, they may be more likely to forget negative stimuli because they are motivated to regulate their emotion. In contrast, young adults may have no such limitation that would reveal preferential forgetting of some material over others.

Conclusions

The purpose of this study was to test whether motivational change toward emotion regulation, that is associated with age but not exclusive to age necessarily, is responsible for a negativity avoidance and positivity bias in attention and memory. We examined the attentional patterns and memory biases of young participants following different motivational inductions. Our main finding was that young participants who were motivated to regulate emotion looked less at both positive and negative stimuli compared with participants in the other two conditions; and participants in the emotional condition looked less at negative stimuli than positive ones. These findings imply that when people want to regulate their emotions, they tend to look away from both positive and negative stimuli. This also suggested that young and older adults may use different strategies in emotion regulation. The effect of motivation was not found in participants' recall memory to differently-valenced stimuli; cognitive ability may therefore play a more important role linking motivation and memory than it does linking motivation and visual attention. More research is needed to further clarify this issue. The current study represents an important step in linking motivation and cognitive processing of emotional material from a lifespan perspective.

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